

## CLAIMS

What is claimed is:

1. A method of generating a collimated beam of high-energy particles comprising:

producing a laser beam having an intensity greater than or equal to about  $10^{18}$  W/cm<sup>2</sup> and a pulse duration less than or equal to about  $10^{-9}$  seconds; and

irradiating an irradiation target capable of releasing high energy ions with said laser beam.

2. The method of claim 1 wherein said irradiation step produces a particle beam with an energy level greater than or equal to about 100keV.

3. The method of Claim 1 wherein said irradiation step produces a particle beam directed to within about 40 degrees of normal to said irradiation target.

4. The method of claim 1 wherein said pulse duration is less than or equal to about  $10^{-11}$  seconds.

5. The method of claim 1 wherein said laser beam has a repetition rate greater than or equal to about  $10^{-3}$  Hz.

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6. The method of claim 1 wherein said irradiation target further

comprises one of a solid, a liquid jet, and a droplet jet.



*Consists  
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7. The method of claim 1 further comprising:

inducing a nuclear reaction by colliding said particle beam into a secondary target containing a nuclei.

8. The method of claim 7 wherein said secondary target is merged

with said irradiation target.

9. The method of Claim 7 wherein said particle beam includes at least

one of protons, deuterons, and tritons.



10. The method of claim 7 wherein said secondary target further

comprises at least one of boron, carbon, nitrogen, oxygen, and neon.

11. The method of claim 7 wherein said particle beam further

comprises protons and said secondary target further comprises at least one of boron-11, boron-10, nitrogen-14, oxygen-16, nitrogen-15, and oxygen-18.

12. The method of claim 7 wherein said particle beam further

comprises deuterons and said secondary target further comprises at least one of boron-10, carbon-12, nitrogen-14, and neon-20.

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13. The method of claim 7 wherein said laser beam includes a pulse

→ interval shorter than a half-life of isotopes produced by said nuclear reaction.

14. The method of claim 7 wherein said particle beam includes excited atomic nuclei.

15. An apparatus for generating a collimated beam of high-energy particles comprising:

a laser adapted to generate a laser beam having an intensity greater than or equal to about  $10^{18}$  W/cm<sup>2</sup> and a pulse duration less than or equal to about  $10^{-9}$  seconds; and

an irradiation target capable of releasing high energy ions disposed in irradiation receiving relation to said laser beam.

16. The apparatus of claim 15 wherein said irradiation target further comprises one of a solid, a liquid jet, and a droplet jet.

17. The apparatus of claim 15 further comprising:

a secondary target containing a nuclei disposed downstream of said irradiation target and receiving a particle beam from said irradiation target to induce a nuclear reaction.

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18. The apparatus of claim 15 wherein said secondary target is merged with said irradiation target.

19. The apparatus of claim 15 wherein said particle beam includes at least one of protons, deuterons, and tritons.

20. The apparatus of claim 15 wherein said secondary target further comprises at least one of boron, carbon, nitrogen, oxygen, and neon.

FOOTNOTES